

The Next Generation of Energy Resource Planning

RETHINKING SYSTEM NEEDS IN A FUTURE
DOMINATED BY RENEWABLES, NEW TECH,
AND ENGAGED CONSUMERS

PRESENTED TO

National Conference of State Legislatures
2019 Legislative Summit

PRESENTED BY

Kathleen Spees

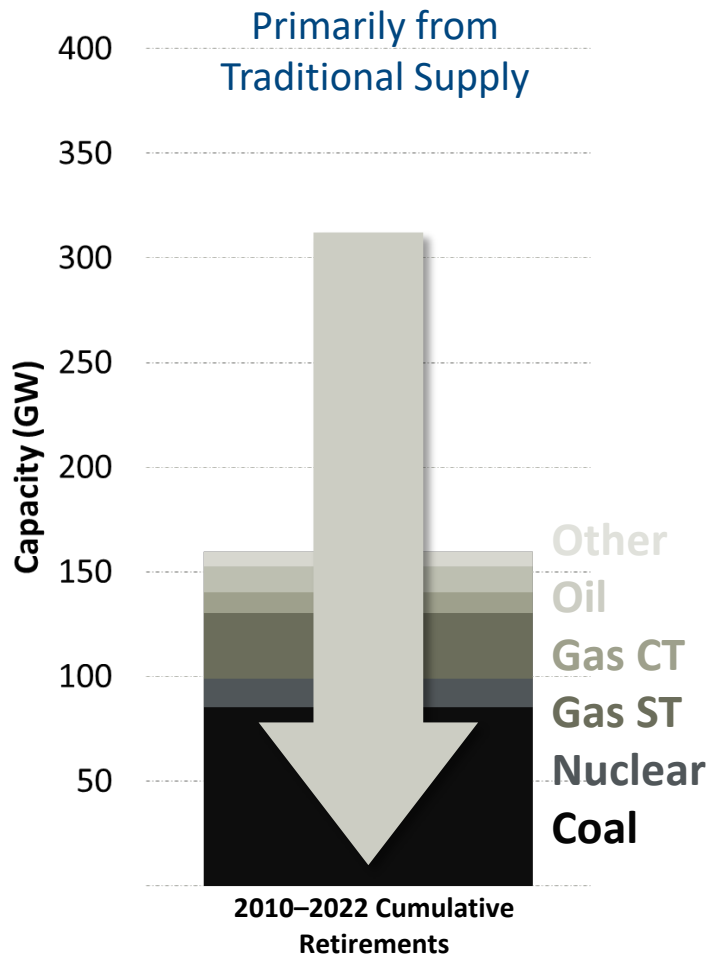
August 4, 2019

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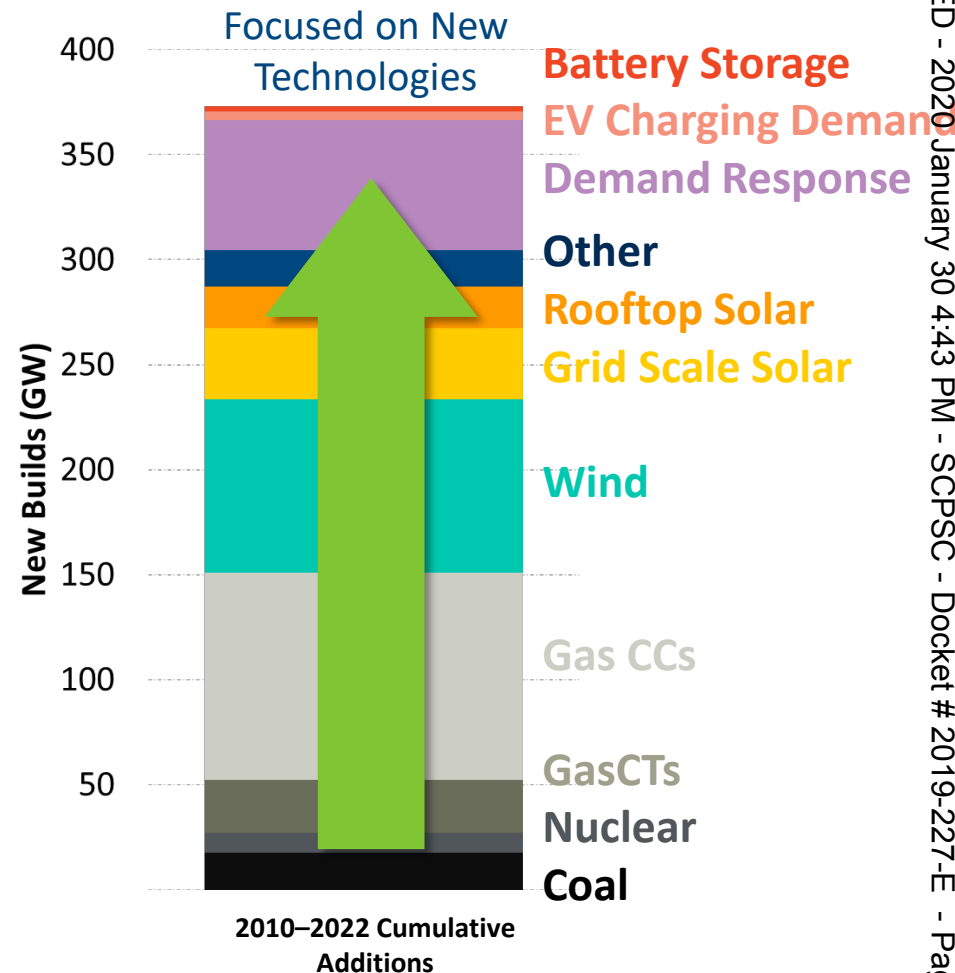


New Technologies & Engaged Customers Are Rapidly Overtaking Traditional Supply

Retirements

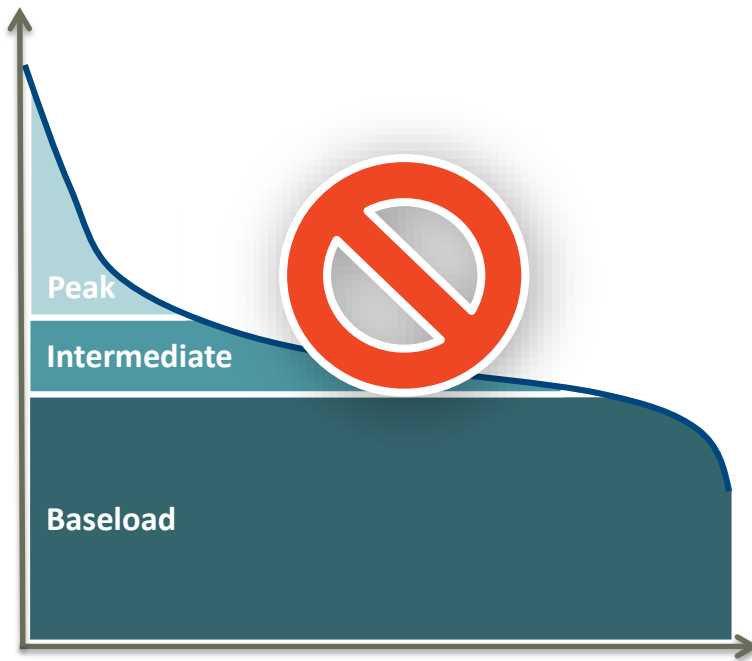


New Builds



The “Old” IRP Model Doesn’t Work Anymore

The Traditional IRP



What’s Missing?

- New reliability & flexibility needs
- Policy goals
- New technologies
- Corporate sustainability goals
- Customer preferences
- Distributed resources uptake
- Electrification vs. grid defection
- Enabling policies & infrastructure

In other words... Traditional IRP approaches are ill-equipped to address almost every major driver that is reshaping the grid!

How Do You “Plan” for the New Grid?

The next generation of modern IRPs may need to...

**Support
Large-Scale
Electrification**

**Redefine
Reliability
Needs**

**Enable New
Technology**

&

**Enhance
Competitive
Procurement**

At Brattle, We Have Had to Completely Rebuild Our Suite of Modeling Tools to Capture These Fundamentally Different Questions

INPUTS: ASSUMPTIONS & SCENARIOS



**ECONOMIC
FUNDAMENTALS**



**TECHNOLOGICAL
CAPABILITIES & UPTAKE
RATES**



POLICY LEVERS

ANALYSIS: BRATTLE'S ADVANCED MODELING SUITE

ELECTRIFICATION & DECARBONIZED ENERGY ECONOMY PLANNING (DEEP) MODEL

DEEP models customer- and policy-driven electrification with a multi-sector model of primary energy production, conversion, emissions, and consumption

TECHNICAL & ECONOMIC POTENTIAL

Fossil, nuclear, demand response, efficiency, on/offshore wind, storage, solar, and DERs

RELIABILITY & FLEXIBILITY NEEDS ASSESSMENT

Capacity, ancillary service, and flexibility grid services

TRANSMISSION PLANNING

Economic and reliability benefit-cost analysis of tradeoffs of resource potential by location

RESOURCE MIX AND DISPATCH

Optimized resource mix and dispatch to meet energy, capacity, ancillary, flexibility, and policy requirements

ECONOMIC IMPACTS ANALYSIS

Broader economic impact of policies and resource plan on employment and local GDP

RESULTS

**OPTIMAL ELECTRICITY
RESOURCE MIX & DISPATCH**

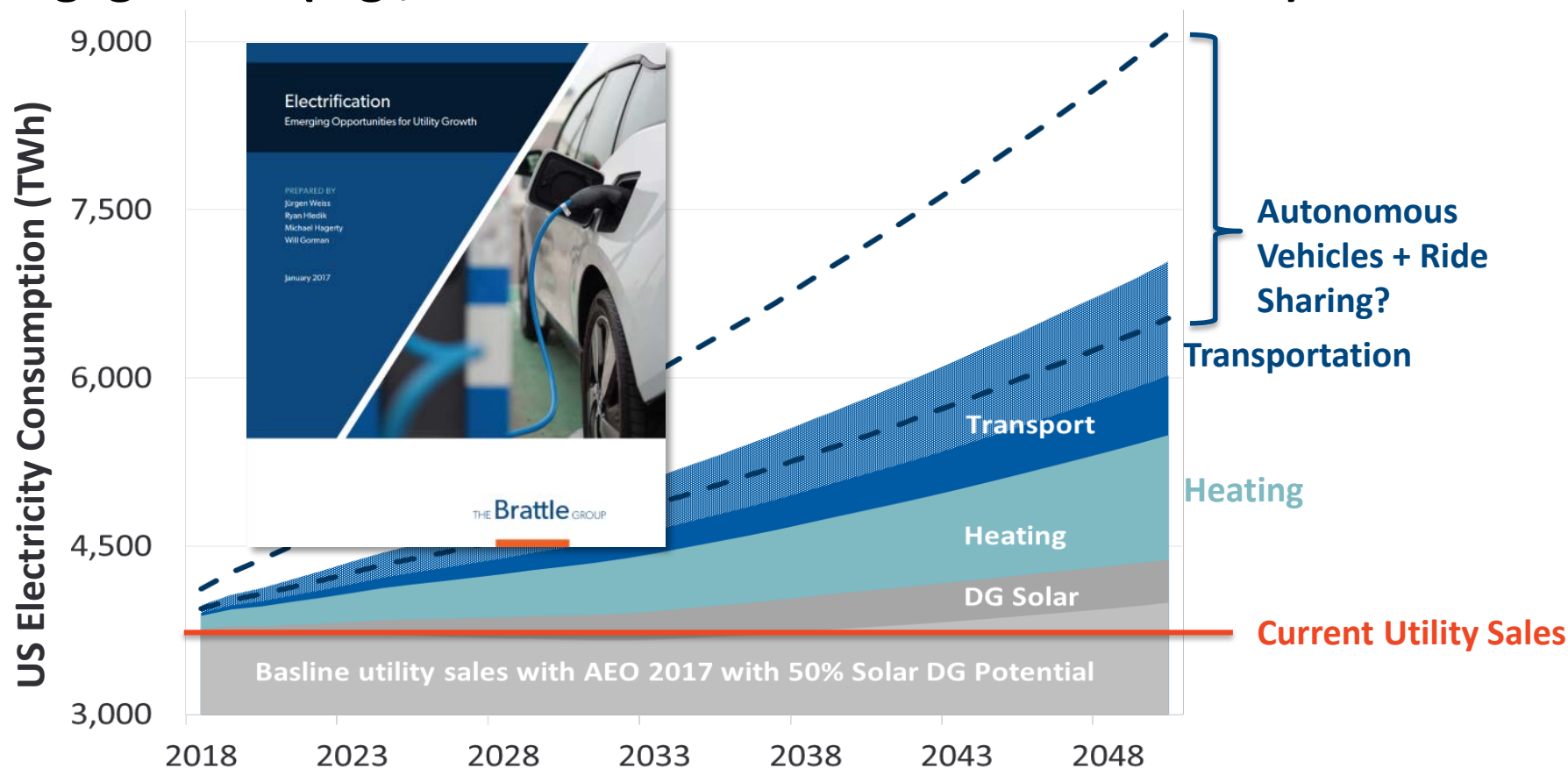
**RATEPAYER &
SOCIETAL COSTS**

**EMISSIONS &
ENVIRONMENT**

The Next Generation of Modern IRPs May Need to... **Support Large-Scale Electrification**

In Many Regions, Electrification Has the Potential to Double Total Demand by 2050

Understanding pace, locations, and resulting infrastructure needs requires deeper understanding of customers, and more active engagement (e.g., if vehicle loads are to be controllable)

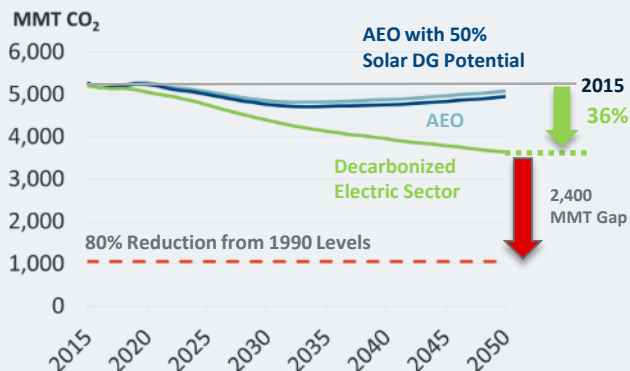


Electrification: Currently the Primary Feasible Path to 80% Decarbonization for States and Cities Aiming to Hit 80x50 Goals

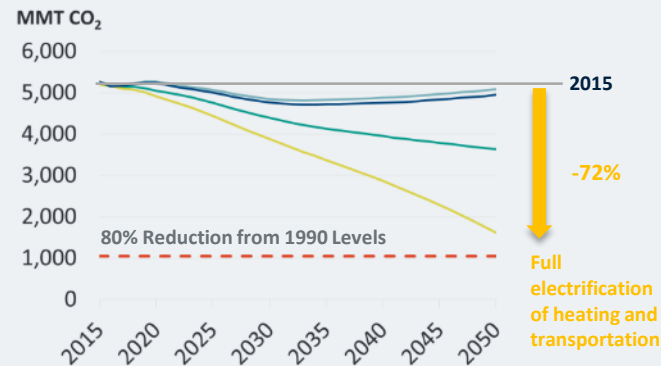


Electrification

**Without Electrification:
36% Carbon Reduction Potential**



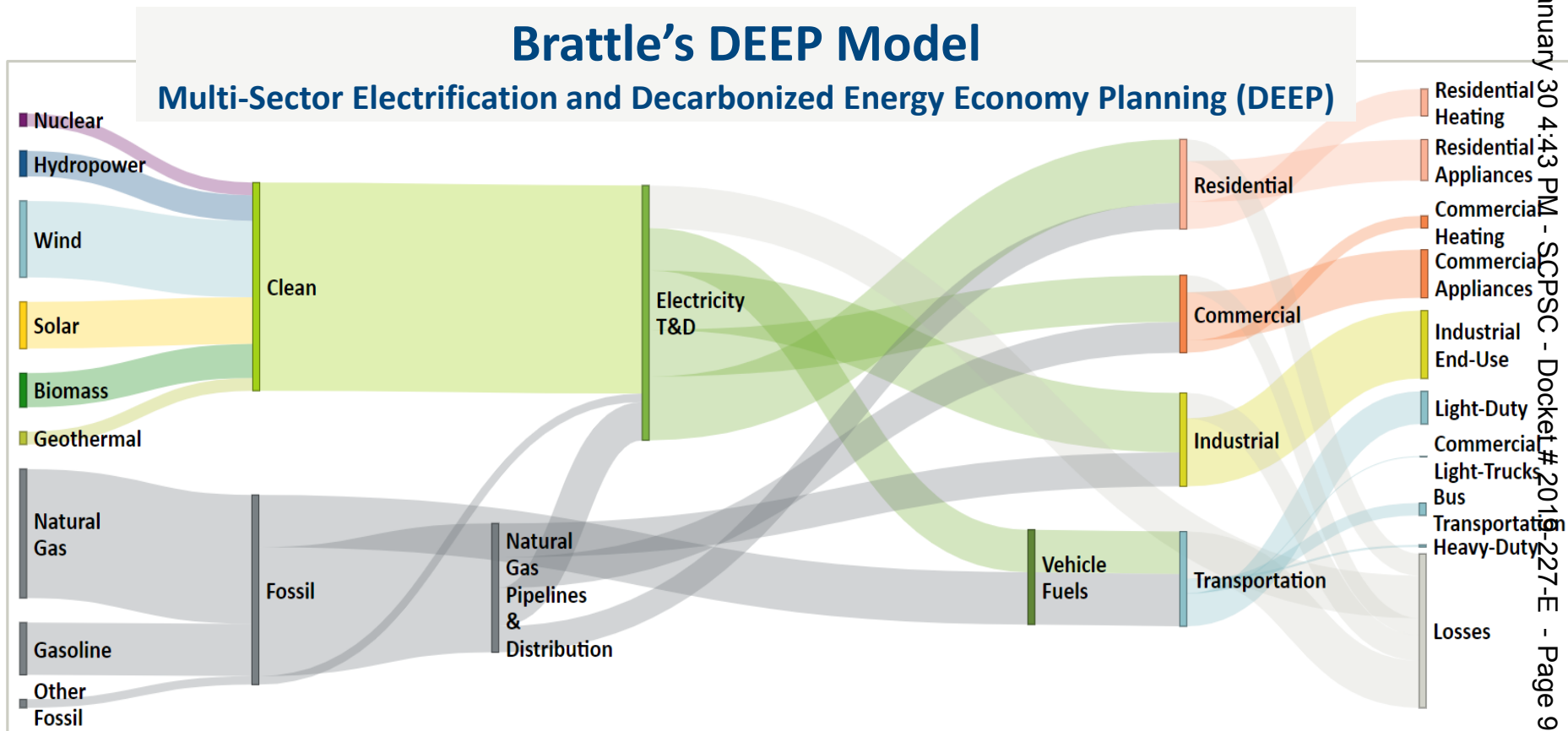
**With Electrification:
72% Carbon Reduction Potential**



Economy-Wide
CO₂e Emissions

How Can Utility and State Planning Account for Electrification-Driven Demand?

Especially in regions with 80x50 goals, states and utilities may need to expand planning to meet energy needs across all energy-intensive economic sectors (considering load, emissions, cost, and job impacts)



The Next Generation of Modern IRPs May Need to...

Redefine Reliability Needs

Transition to a Cleaner Grid: Are We Headed for Blackouts When the Sun Goes Down?

Myths

Intuition may give us a false sense that the grid won't stay reliable unless we....

- Save baseload plants from retirement (or coal, or nuclear, or gas)
- Save a specific “favored” plant
- Stop building renewables
- Build a gas pipeline
- Impose on-site fuel requirements

Realities

It's not all hype. It will be a big challenge to maintain reliability while going clean...

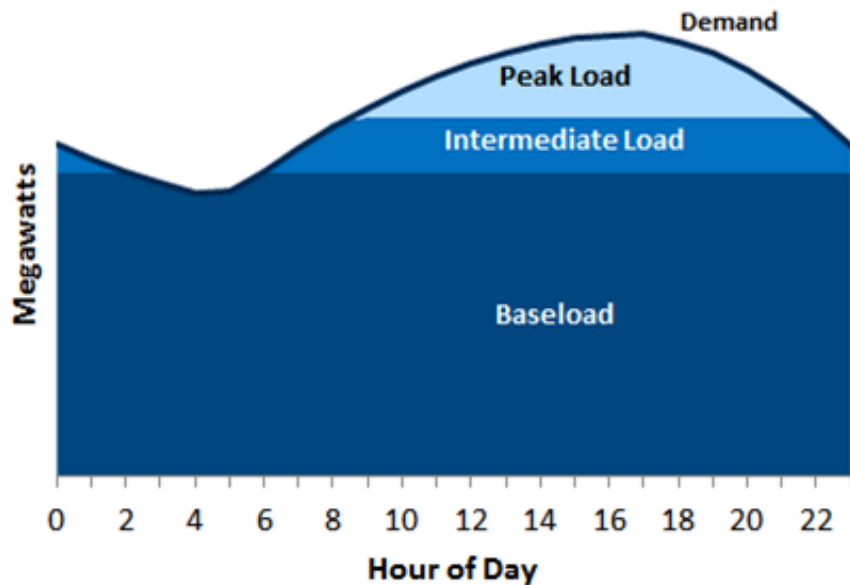
- Many customers and policymakers want to go clean (reliability concerns won't stop them)
- Intermittent renewables do not provide the same bundle of reliability services as traditional thermal plants
- Grid services we used to get “for free” will need to be defined and paid for
- Grid operators must learn to rely on non-traditional resources to provide these grid services
- Customers may prefer to save money by allowing some outages

To Clarify: Why Do We Need “Baseload” Plants Again?

.... We don’t. We can drop “baseload” from planning vocabulary.

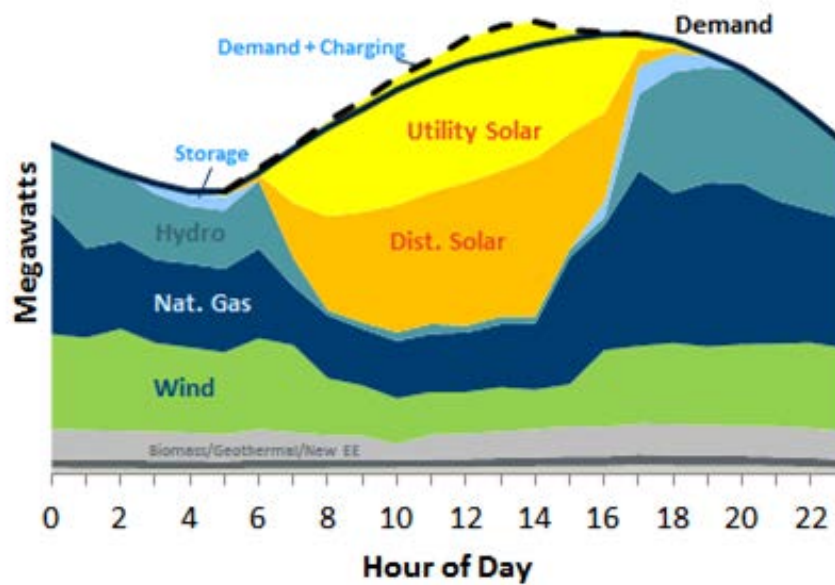
Traditional Planning

Concept: Baseload plants contributed to a cost-effective resource mix and provided many grid services “for free” as a byproduct of producing energy.



Future Supply Mix

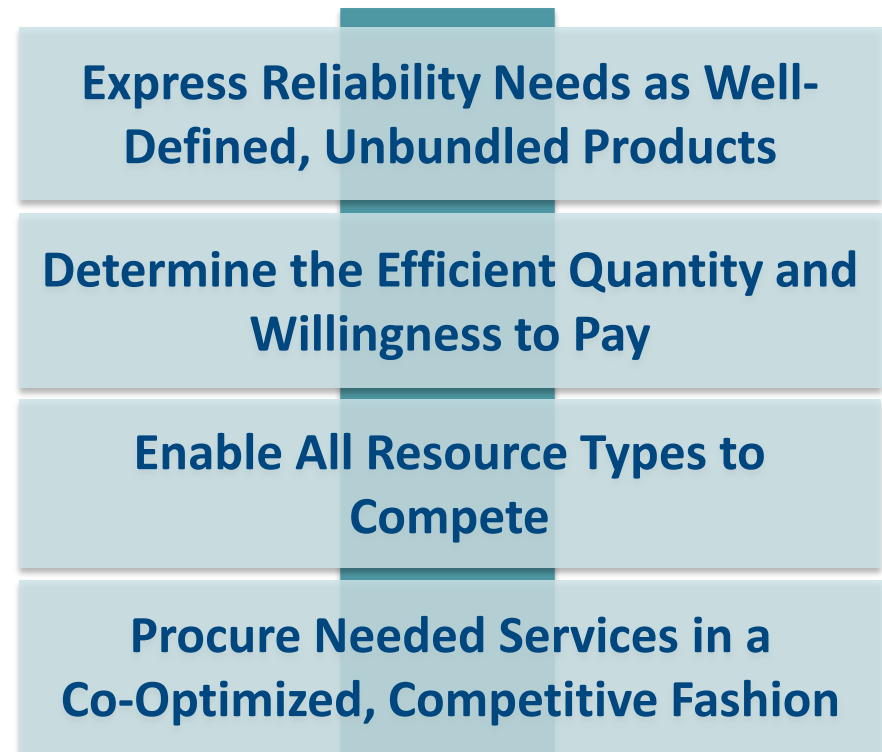
Concept: Equation is flipped. Energy will be “free” most of the time. Flexibility and other grid services have to be defined and paid for.



How Should Advanced Resource Plans Rethink Reliability Needs?

- **Easy (but wrong):** First instinct of RTOs and utilities may be to continue relying on traditional thermal plants even as they become uneconomic
- **Harder (but right!):** Do the hard work of fully specifying a comprehensive suite of unbundled grid services... *before* the problem becomes an emergency requiring costly interventions

How Do You Maintain Reliability at Low Cost in High-Renewable Systems?



Properly Decomposing System Needs Can Enable Grid Transition at Lower Costs

Compared to traditional planning and procurement, technology-neutral (capability-based) evaluations are more competitive

Technology Types

	Coal	CC	CT	Nuclear	Hydro	Storage	Wind	Solar	Battery Storage	DR	EE	Imports
Day-Ahead Energy	✓	✓	○	✓	✓	✓	✓	✓	○	○	○	✓
Real-Time Energy (5 Min)	✓	✓	○	○	✓	✓	✓	✓	○	○	○	○
Regulation	✓	✓	○	✗	✓	✓	○	○	✓	○	✗	○
Spinning Reserves	✓	✓	✓	✗	○	✓	✗	✗	✓	○	✗	○
Non-Spinning Reserves	✗	✓	✓	✗	✗	✓	✗	✗	✓	○	✗	○
Load following / Flexibility	○	✓	✓	○	○	✓	○	○	✓	○	✗	○
Capacity	✓	✓	✓	✓	○	✓	○	○	○	✓	✓	✓
Clean Attributes (RECs)	✗	○	○	✓	✓	✓	✓	✓	○	○	✓	✓
Reactive / Voltage Support	✓	✓	✓	✓	✓	✓	○	○	✓	✗	✗	○
Black Start	○	✓	✓	✗	✓	✓	✗	✗	○	✗	✗	○

Technical Capability for Service

- ✓ Well Suited
- Somewhat Capable
- ✗ Not / Poorly Suited

Even non-traditional & carbon-free supply can provide essential grid services (if enabled to compete)

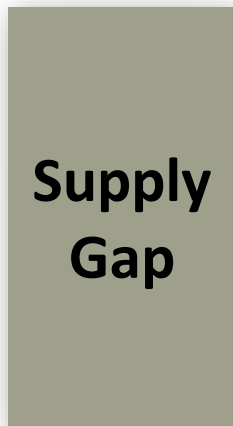
The Next Generation of Modern IRPs May Need to...

Enable New Technologies

Typical Question: How to Replace a Retiring Coal Plant?

Resources Needed

To meet Load Growth + Retirements



Traditional Planning Model Proposes:



Because....

- Gas is the cheapest “baseload” (high energy & capacity value)
- Renewables offer cheap energy but require 100% gas backup for reliability

Modern IRP Approaches May Identify:

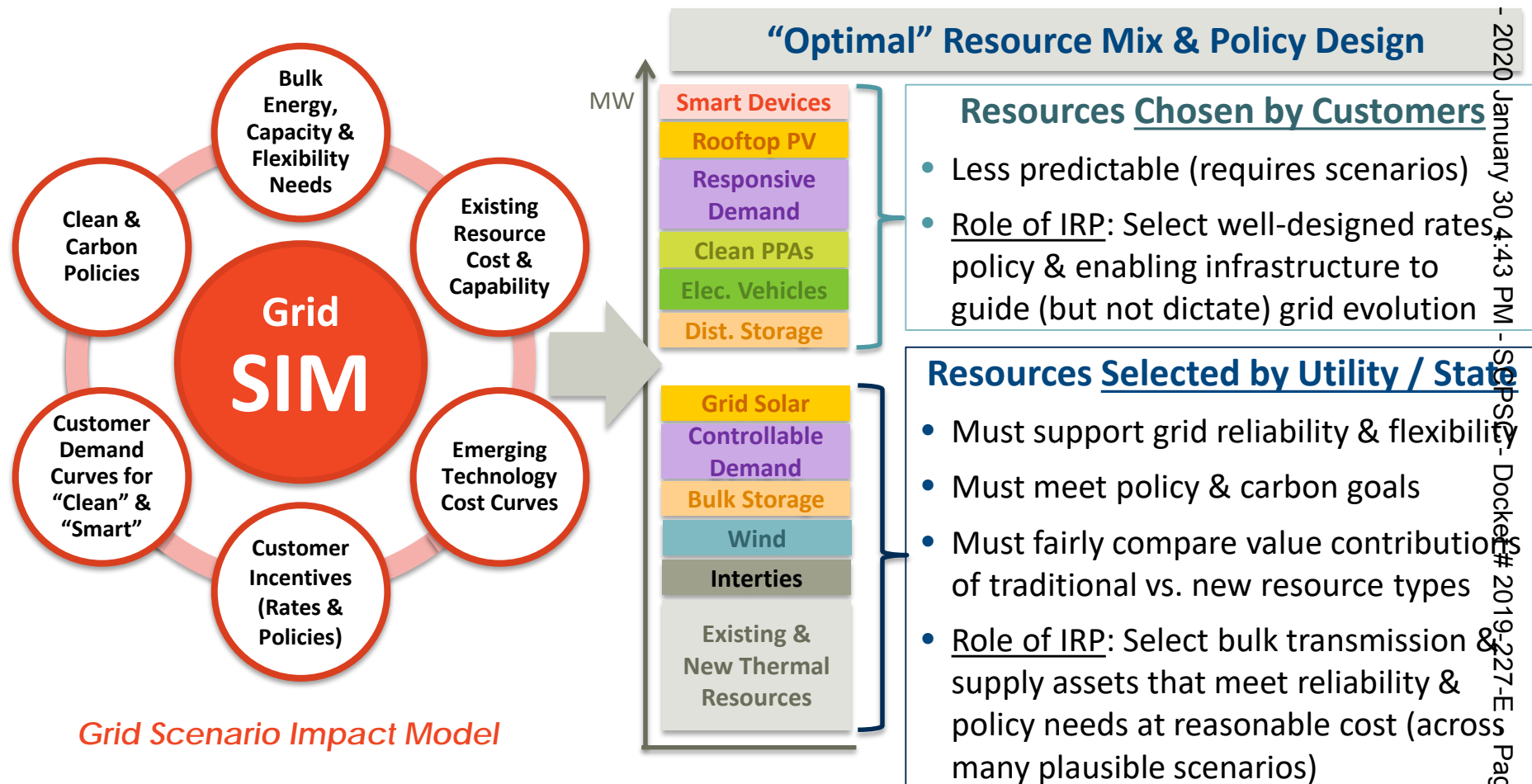


Because....

- Renewables + DR/storage is cheaper than gas (depending on scenario)
- Together these resources can meet all energy, flexibility & capacity needs
- They may offer additional system values: T&D, clean attributes

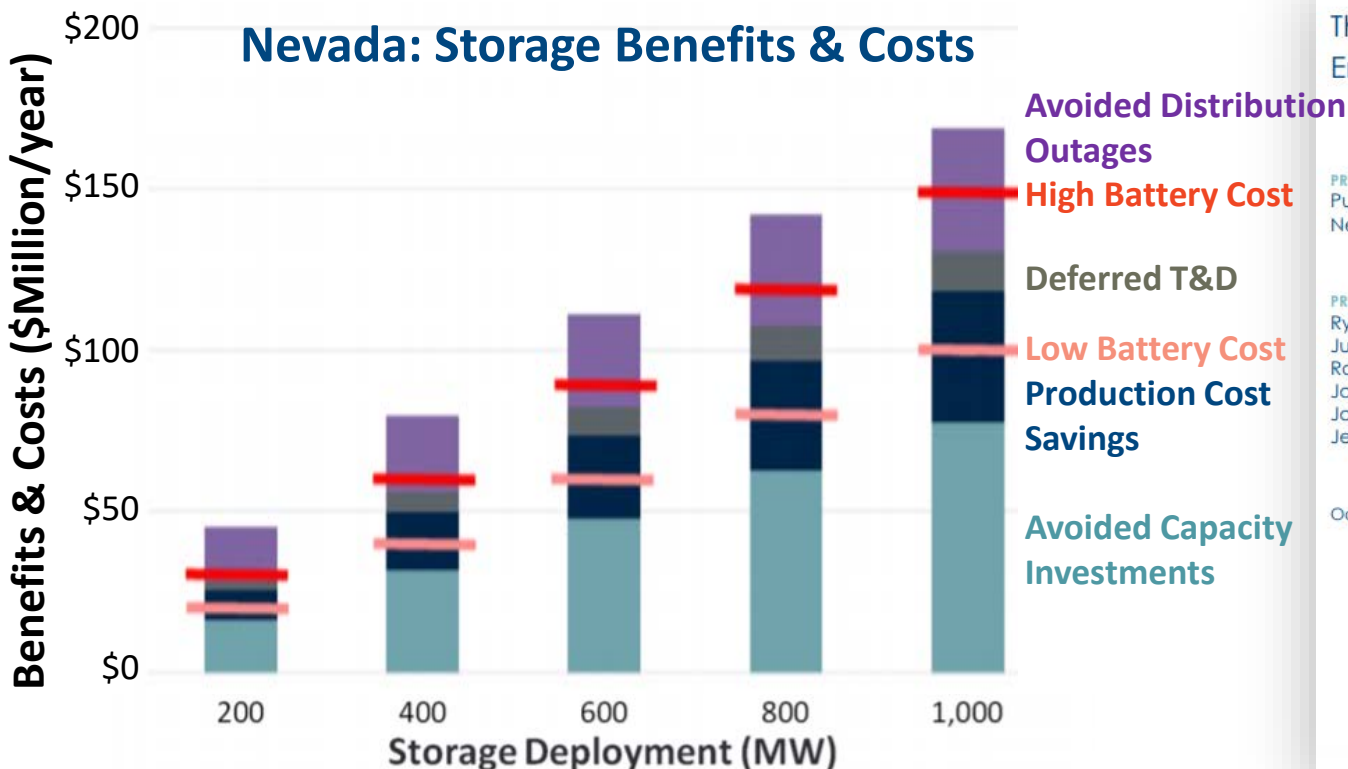
How Should a Modern Resource Plan Fairly Evaluate Disparate Technologies?

Planning tools and methods have to fully account for all system needs and all resource types' capabilities on a level playing field



Example: Brattle Estimates 700–1,000 MW Nevada Storage Potential (50,000 MW US-Wide!)

Achieving economic potential depends on “stacking” value streams: energy, ancillaries, capacity, T&D, environmental, and avoided outages



The Economic Potential for Energy Storage in Nevada

PREPARED FOR
Public Utilities Commission of Nevada
Nevada Governor's Office of Energy

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Ryan Hledik
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October 1, 2018

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The Next Generation of Modern IRPs May Need to... **Enhance Competitive Procurement**

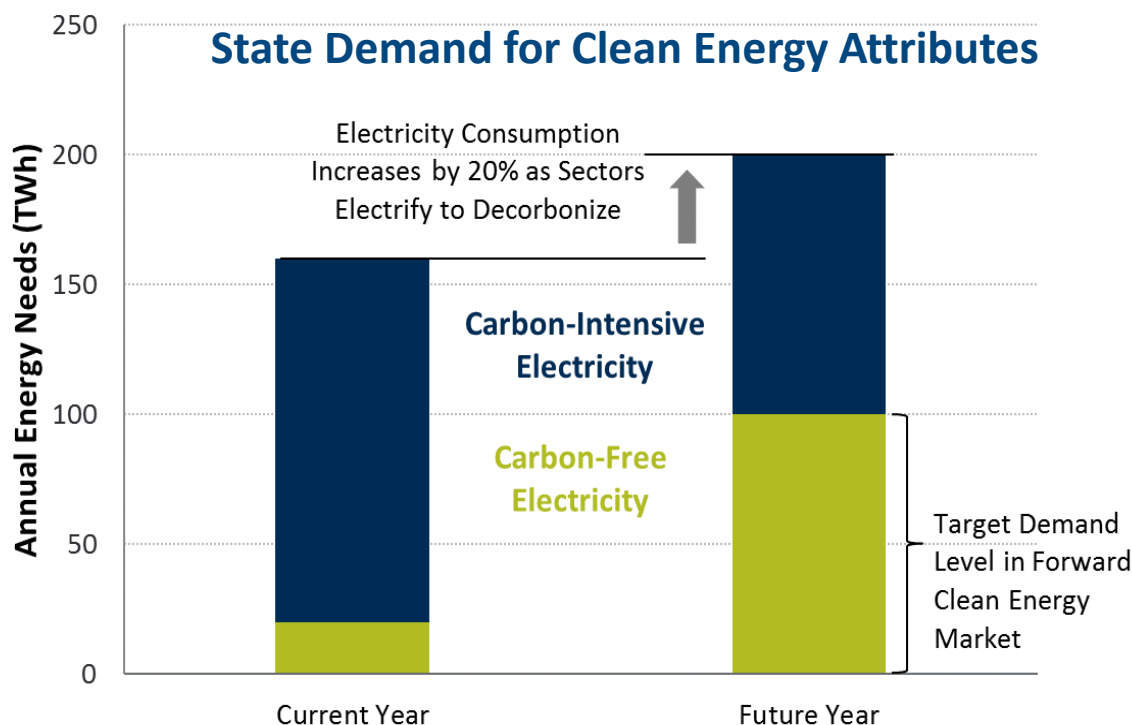
How Can Competitive Procurements Enable More Competition?

Following best practices in all-source, competitive procurements can invite innovative solutions that may not have been considered in the resource planning:

- Subject high-impact resource planning decisions to a **“market test” and all-source solicitation** to help identify lower-cost solutions
- Establish **product definitions** that match the underlying system needs (define the need, not a resource type)
- **Unbundle all services** to maximize competition across markets and technologies
- **Technology-neutral** qualification and uniform-price payments for suppliers of each service
- Broad **regional competition**
- **Open, transparent solicitation process** designed to co-optimize across needs at lowest cost
- Care to ensure **alignment with energy, ancillary, and capacity markets** where relevant

Example: Forward Clean Energy Market for States, Cities, and Customers with Large-Scale Decarbonization Goals

Best-practices design proposal is the basis for draft legislation in multiple states. Would enable all-source competition to achieve clean energy needs at lower costs than traditional PPAs



How States, Cities, and Customers Can Harness Competitive Markets to Meet Ambitious Carbon Goals

THROUGH A FORWARD MARKET FOR CLEAN ENERGY ATTRIBUTES

PREPARED FOR



PREPARED BY

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April 2019

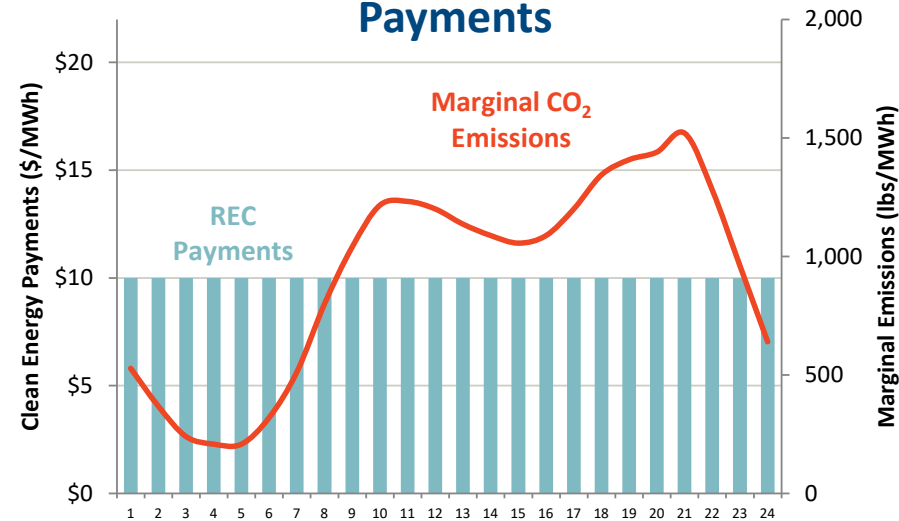
Sources and Notes:

See the full design proposal in [How States, Cities, and Customers Can Harness Competitive Markets to Meet Ambitious Carbon Goals Through a Forward Market For Clean Energy Attributes](#), April 2019.

Better Product Definition: Achieves Faster Decarbonization at a Lower Cost

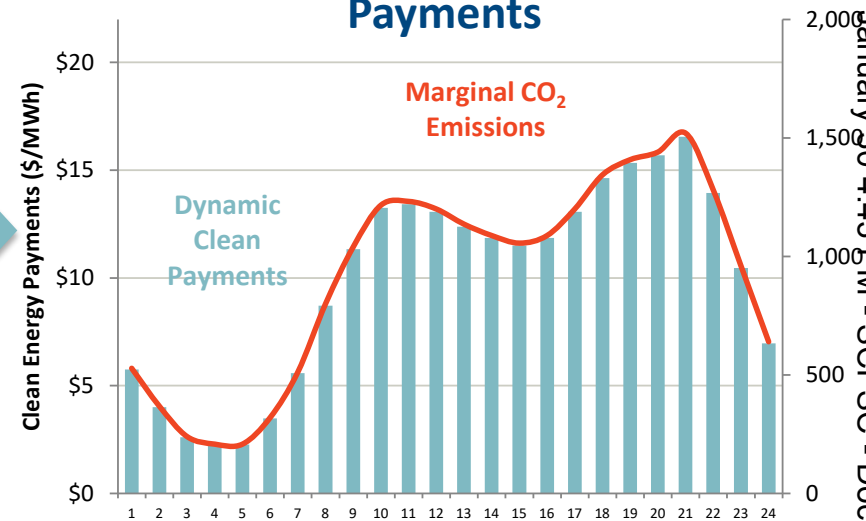
Enhanced “dynamic” clean energy attributes approach would align payments with marginal carbon abatement

Illustrative Traditional REC Payments



- Flat payments over every hour
- Incentive to offer at negative energy prices during excess energy hours

Illustrative “Dynamic” Clean Payments



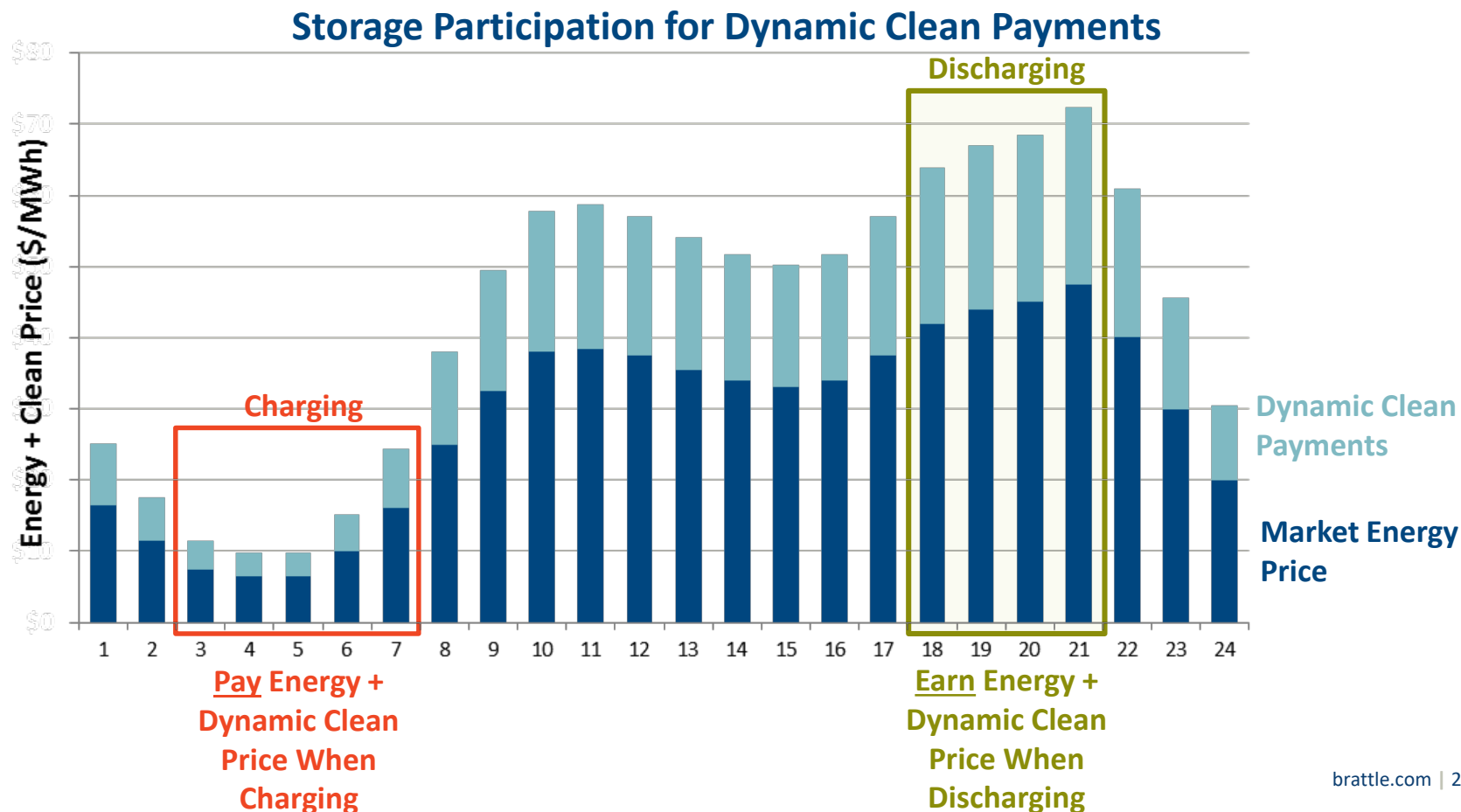
- Payments scale in proportion to marginal CO₂ emissions (by time and location)
- Incentive to produce clean energy when and where it avoids the most CO₂ emissions
- No incentive to offer at negative prices

Sources and Notes:

See the full design proposal here: http://www.nepool.com/uploads/IMAPP_20170517_LT_Staw_Dynam_Clean_Energy_Market.pdf

Enabling Competition: Lets Innovative Players Identify Creative Solutions

Dynamic payments incentivize clean energy at the right times to displace the most CO₂ emissions, enabling storage to compete with other technologies



Takeaway:

It's time to rethink nearly every aspect of the traditional IRP to...

**Support
Large-Scale
Electrification**

**Redefine
Reliability
Needs**

**Enable New
Technology**

&

**Enhance
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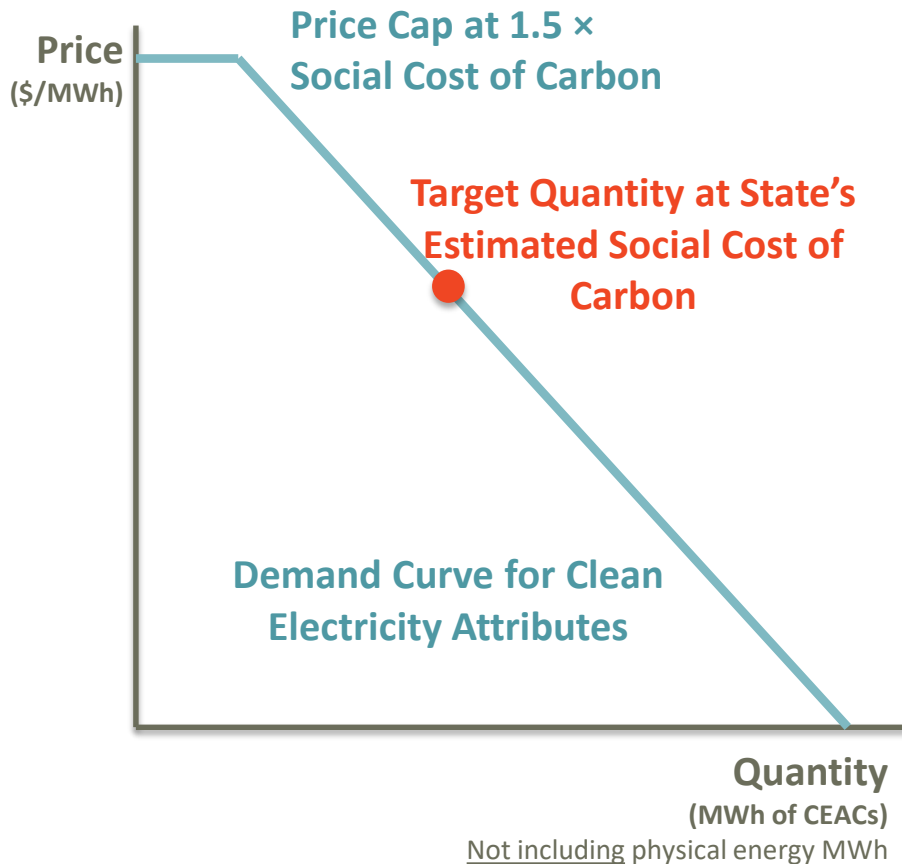
Appendix

How Would the Forward Clean Energy Market Work?

Best practices design would maximize competition and enable new investment when needed

Design Features

- Unbundled procurement of clean energy attribute credits (CEACs)
- Resource neutral (renewables, nukes, existing/new)
- 3-years forward, 1-year delivery period
- 7-year price lock-in for new supply
- Uniform price auction
- Downward-sloping demand curve
- Developers face merchant risk in CEAC, energy, and capacity markets
- States procure 100% of needs every year, creating stability to sellers
- Voluntary buy bids enabled from cities, companies, and retailers



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Dr. Kathleen Spees is a principal at The Brattle Group with expertise in designing and analyzing wholesale electric markets and carbon policies. Dr. Spees has worked with market operators, transmission system operators, and regulators in more than a dozen jurisdictions globally to improve their market designs for capacity investments, scarcity and surplus event pricing, ancillary services, wind integration, and market seams. She has worked with US and international regulators to design and evaluate policy alternatives for achieving resource adequacy, storage integration, carbon reduction, and other policy goals. For private clients, Dr. Spees provides strategic guidance, expert testimony, and analytical support in the context of regulatory proceedings, business decisions, investment due diligence, and litigation. Her work spans matters of carbon policy, environmental regulations, demand response, virtual trading, transmission rights, ancillary services, plant retirements, merchant transmission, renewables integration, hedging, and storage.

Dr. Spees earned her Ph.D. in Engineering and Public Policy within the Carnegie Mellon Electricity Industry Center and her M.S. in Electrical and Computer Engineering from Carnegie Mellon University. She earned her B.S. in Physics and Mechanical Engineering from Iowa State University.

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 Electric Transmission
 Electricity Market Modeling & Resource Planning
 Electrification & Growth Opportunities
 Energy Litigation
 Energy Storage
 Environmental Policy, Planning and Compliance
 Finance and Ratemaking
 Gas/Electric Coordination
 Market Design
 Natural Gas & Petroleum
 Nuclear
 Renewable & Alternative Energy

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 Analysis of Market Manipulation
 Antitrust/Competition
 Bankruptcy & Restructuring
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 Commercial Damages
 Environmental Litigation & Regulation
 Intellectual Property
 International Arbitration
 International Trade
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